



Cost Schedule Update and Review

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Cost Schedule Update and Review

- Delivery schedule of the cost table update:
 - Appendices C and G released on October 31, 2014.
 - Errata released January 9, 2015.
 - Updated schedules to be used for 2015 annual adjustment and start of cyclical reassessment.
- Why were updated schedules needed?
 - Construction costs have changed.
 - Construction methods, design, materials have changed.
 - Cost model assumptions needed review & update.



Cost Schedule Update and Review

- What goals were set for doing the update?
 - Minimize the cost.
 - No change in data collection requirements.
 - Retain existing format to minimize software impact.



Cost Schedule Update and Review

- If Indiana's assessment standard is "market-value-in-use", why are cost schedules needed?
 - Construction cost provides the foundation from which sales calibration analysis and adjustments begin.
 - Cost of construction is understandable to most people.
 - Cost method often used for properties that rarely sell.
 - Cost method provides additional support for values of newer properties.



Cost Schedule Update and Review

- Exactly what is replacement cost new (RCN)?
 - Definition: Replacement cost new (RCN) is the cost, including material, labor, and overhead, that would be incurred in constructing an improvement having the same utility to its owner as a subject improvement, without necessarily reproducing exactly any particular characteristics of the subject (IAAO 1997, p. 120).
- Fact: Building design, materials, and construction methods have undergone many changes during the past few years.
- Hence, a replacement structure will likely be different in design and materials from the original improvement.



Cost Schedule Update and Review

- What is a “Cost Model” and why is it needed?
- Building material and labor costs are tracked by specialized publishers for commercial use by insurance companies and the construction industry, as well as appraisers.
- Contractors use the published cost data for creating detailed cost estimates from building plans.
- Appraisers need a cost approach estimating model that gives the best trade-off between **accuracy** and **time invested**.
- The same building material and labor cost data can give different estimating accuracy, depending upon the cost model used – this will be shown later with Craftsman data.



Cost Schedule Update and Review

Examples of Cost Estimating Model Differences

(Moore: 1995 IAAO Conference Presentation, “Stratified Cost Approach”, p 228)

Cost Manual	<u>Cost Table Organization</u>			<u>Quality Adjustment</u>	
	Styles	Floor Level	Size	Separate Table	Multiplier
A. Marshall & Swift Residential Cost Handbook	X		X	X	
B. Iowa & Illinois Manuals*	X		X		X
C. Missouri/Hunnicut			X		X
D. Oregon Manual		X	X	X	
E. Indiana Manual		X	X		X

* Most other cost manuals published by mass appraisal firms use method B.

Figure 2. Traditional methods of Cost Manual Unit Comparisons



Cost Schedule Update and Review

- **Accurate Cost Model Assumptions Are Needed**
- All models attempt to simulate the real world.
 - Models require assumptions.
 - A typical structure must be defined by RCN model assumptions.
 - Building construction design and methods have changed.
 - Most original cost approach model assumptions are not available.
- Therefore, the first step is to define assumptions.



Cost Schedule Update and Review

- Residential Model Assumptions
- Model assumptions formed from real world observation
- Benchmark house sizes to fit data and span Schedule A:
100 400 600 800 1000 1200 1300 1400
1500 1600 1800 2400 3200 4000 5000
- From 2010 new house floor plans, the Department determined construction characteristics for each floor level:
 - Average perimeter linear feet at each benchmark house size
 - Average linear feet of interior walls at each benchmark house size
 - Number of single window equivalents at each benchmark house size
 - Number of exterior and interior doors at each benchmark house size
 - Average linear feet of attached garage common wall
 - Typical roof pitch for each house type:
 - One story, two story, part upper floor ($\frac{1}{2}$ & $\frac{3}{4}$ story), attic level



Cost Schedule Update and Review

Benchmark model calculation worksheet by size

Cost Source: Craftsman Book Co																12/1/2010
2011 National Construction Estimator																
	INDIANA 2011 REPLACEMENT COST NEW (RCN) MODEL WORKSHEET															
	Average Quality 'C' Class - "Standard or Normal Construction"															
	COST MODEL ASSUMPTIONS															
ITEM																
Base Floor Size	100	400	600	800	1000	1200	1300	1400	1500	1600	1800	2400	3200	4000	5000	
Half Upper Floor Usable SF @ 59% of Base	59	236	354	472	590	708	767	826	885	944	1062	1416	1888	2360	2950	
3/4 Upper Floor Usable SF @ 78% of Base	78	312	468	624	780	936	1014	1092	1170	1248	1404	1872	2496	3120	3900	
Attic Usable SF @ 40% of Base	40	160	240	320	400	480	520	560	600	640	720	960	1280	1600	2000	
Perimeter Linear Feet	50	82	106	120	137	156	165	170	178	186	204	234	303	360	425	
One Story Perimeter LF shared with Att Garage	20	20	24	27	27	27	27	27	27	27	27	27	27	27	27	
Two Story Perimeter LF shared with Att Garage	20	20	22	25	32	32	32	32	32	32	32	32	32	32	32	
Average Gable End Width	8	16	24	27	29	30	32	32	32	33	35	36	38	40	40	
Number of gable Ends	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	4	
Standard Roof Pitch	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Half Story Roof Pitch with dormer factor	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
Attic Roof Pitch - no dormers	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
Standard Gable End Wall Area (pitch=6)	16	64	144	228	263	281	320	320	320	340	383	405	451	600	800	
Gable End Wall Area for 1/2 Story (pitch=9)	24	96	216	342	394	422	480	480	480	510	574	608	677	900	1200	
Gable End Wall Area for Attic (pitch=7)	19	75	168	266	307	328	373	373	373	397	447	473	526	700	933	
Standard Pitch Roof Area (with overhang)	112	448	672	896	1120	1344	1456	1568	1680	1792	2016	2688	3584	4480	5600	
Roof Area for 1/2 Story Pitch (with overhang)	126	504	756	1008	1260	1512	1638	1764	1890	2016	2268	3024	4032	5040	6300	
Roof Area for Attic Story Pitch (with overhang)	116	464	696	928	1160	1392	1508	1624	1740	1856	2088	2784	3712	4640	5800	
Dormer Linear Feet to Base Size Factor	0.0250	0.0152	0.0133	0.0117	0.0108	0.0093	0.0082	0.0077	0.0073	0.0069	0.0062	0.0050	0.0047	0.0045	0.0043	
Linear Feet of Dormer for Half Story	3	6	8	9	11	11	11	11	11	11	11	12	15	18	22	
One Story Home Interior Partitions LF	12	47	71	94	118	142	154	165	177	188	212	282	366	450	560	
1st Floor Interior Partitions of Two Story Home	8	32	48	64	80	96	104	112	120	130	148	196	262	330	416	
Interior Partition LF Adjust of Two Story Home	(4)	(15)	(23)	(30)	(38)	(46)	(50)	(53)	(57)	(58)	(64)	(86)	(104)	(120)	(144)	
Full Upper Floor Interior Partitions LF	18	68	98	126	150	176	188	192	204	216	242	316	410	504	620	
Half Story Interior Partitions LF	19	71	103	132	138	151	165	178	190	201	220	245	318	391	481	
Attic Interior Partitions LF @ 50% of Half Story	10	36	52	66	69	76	83	89	95	101	110	123	159	196	241	
Exterior Doors Excluding Main Entrance	1	1	1	1	2	2	2	2	2	2	2	2	2	3	4	
Std Interior Doors of One Story Homes	1	3	4	6	8	9	11	11	11	12	12	14	16	22	30	
1st Floor Std Interior Doors of Two Story Homes	1	2	3	4	5	5	5	6	6	7	7	9	12	16	20	
Std Interior Door Adjust of Two Story Home	0	(1)	(1)	(2)	(3)	(4)	(6)	(5)	(5)	(5)	(5)	(5)	(4)	(6)	(10)	
Full Upper Floor Std Interior Doors	2	4	6	8	10	10	10	10	10	12	14	16	18	21	24	



Cost Schedule Update and Review

Closer look at Cost Model Assumptions: Exterior Closure & Roof

G18		=ROUND(G\$13*((0.5*G\$12*G15)/12)*0.5*G\$12,0)							
	A	D	E	F	G	H	I	J	K
1	Cost Source: Craftsman Book Co	INDIANA 2011 REPLACEMENT COST NEW (RCN) MODEL WORKSHEET							
2	2011 National Construction Estimator	Average Quality 'C' Class - "Standard or Normal Construction"							
3		COST MODEL ASSUMPTIONS							
4	ITEM								
5	Base Floor Size	600	800	1000	1200	1300	1400	1500	1600
6	Half Upper Floor Usable SF @ 59% of Base	354	472	590	708	767	826	885	944
7	3/4 Upper Floor Usable SF @ 78% of Base	468	624	780	936	1014	1092	1170	1248
8	Attic Usable SF @ 40% of Base	240	320	400	480	520	560	600	640
9	Perimeter Linear Feet	106	120	137	156	165	170	178	186
10	One Story Perimeter LF shared with Att Garage	24	27	27	27	27	27	27	27
11	Two Story Perimeter LF shared with Att Garage	22	25	32	32	32	32	32	32
12	Average Gable End Width	24	27	29	30	32	32	32	33
13	Number of gable Ends	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
14	Standard Roof Pitch	6	6	6	6	6	6	6	6
15	Half Story Roof Pitch with dormer factor	9	9	9	9	9	9	9	9
16	Attic Roof Pitch - no dormers	7	7	7	7	7	7	7	7
17	Standard Gable End Wall Area (pitch=6)	144	228	263	281	320	320	320	340
18	Gable End Wall Area for 1/2 Story (pitch=9)	216	342	394	422	480	480	480	510
19	Gable End Wall Area for Attic (pitch=7)	168	266	307	328	373	373	373	397
20	Standard Pitch Roof Area (with overhang)	672	896	1120	1344	1456	1568	1680	1792
21	Roof Area for 1/2 Story Pitch (with overhang)	756	1008	1260	1512	1638	1764	1890	2016
22	Roof Area for Attic Story Pitch (with overhang)	696	928	1160	1392	1508	1624	1740	1856



Cost Schedule Update and Review

- New Cost Model Creation Steps
 - Place Cost Model Assumptions in the benchmark model size calculation worksheet (previous slides).
- **Following Slides:**
 - Organize information in Excel using UNIFORMAT II.
 - Place elemental component and assembly unit costs in spreadsheet.
 - Calculate building costs at benchmark square foot building sizes.



Cost Schedule Update and Review

Organize information in Excel using UNIFORMAT II

Figure 1. ASTM UNIFORMAT II - Classification of Building Elements (E1557-97)

ASTM UNIFORMAT II - Classification of Building Elements (E1557-97)		
Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
A. SUBSTRUCTURE	A10 Foundations	A1010 Standard Foundations A1020 Special Foundations A1030 Slab on Grade
	A20 Basement Construction	A2010 Basement Excavation A2020 Basement Walls

45	UNIFORMAT II Computational Detail
46	A. SUBSTRUCTURE
47	A10 Foundations
48	A1010 Standard Foundations
49	One Story Structure
50	1.5 or Two Story Structure
51	A1020 Special Foundations
52	A1030 Slab on Grade
53	A20 Basement Construction
54	A2010 Basement Excavation
55	A2020 Basement Walls

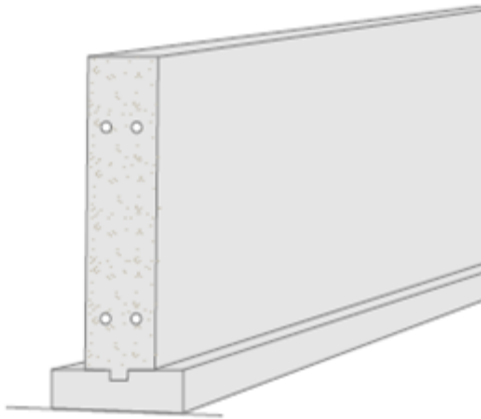


Cost Schedule Update and Review

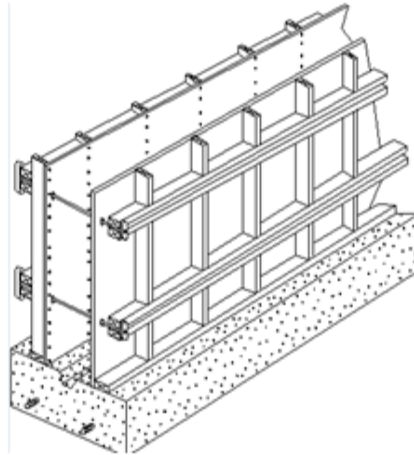
Dwelling Foundation Cost Computation Example

Real Property Assessment Guide – Version A, Table A-3 Grade C, Page 10 (Referenced as “Table A-3”)

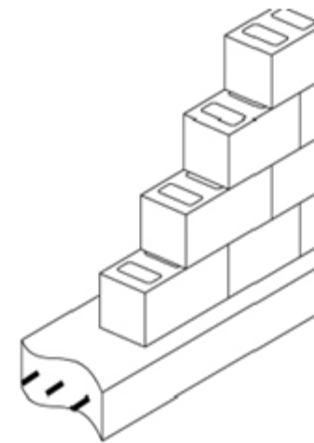
Table A-3 Foundations: 8” poured concrete or 8” concrete block



Footing with keyway



Forms for a poured concrete stem wall



Concrete blocks on footing

A stem wall placed on a spread footing (or simply *footing*) has long been considered the standard foundation. The spread footing distributes the weight of the structure over a larger area. A residential footing is usually 18 inches wide and 8 inches deep. It's normally reinforced with two horizontal bars of #4 grade 60 or #5 grade 40 steel reinforcement. You attach the spread footing to the stem wall with a keyway and/or steel rebar dowel uprights (Diller & Diller, p 150, 159, NCE, p. 92-93).



Cost Schedule Update and Review

Applying the 2014 Craftsman Cost Data Dwelling Foundation Cost Computation Example

Craftsman Assembly: Continuous concrete footing with foundation stem wall. These figures assume the foundation stem wall projects 24" above the finished grade and extends into the soil 18" to the top of the footing. Costs shown include typical excavation using a 3/4 CY backhoe with excess backfill spread on site, forming both sides of the foundation wall and the footing, based on three uses of the forms and 2 #4 rebar. Use \$1,200.00 as a minimum cost for this type work (NCE, p. 92).

2014 Costs	<u>Craft@Hrs</u>	Unit	Material	Labor	Equipment	Total
Typical cost per CY	B5@7.16	CY	156.00	254.00	50.90	463.90
Typical single story structure, footing 12" W x 8" D, wall 6" T x 42" D (.10 CY per LF)	B5@.716	LF	15.90	25.40	5.09	46.39
Typical two story structure, footing 18" W x 10" D, wall 8" T x 42" D (.14 CY per LF)	B5@1.00	LF	22.30	35.50	7.11	64.91
Typical three story structure, footing 24" W x 12" D, wall 10" T x 42" D (.19 CY per LF)	B5@1.36	LF	30.20	48.20	9.67	88.07



Cost Schedule Update and Review

- Commercial Cost Model Data PAR/Size Points
- Microsoft Excel **Solver** used to determine model benchmark data:
 - found the best dimensions for each PAR.
 - set the object function to minimize perimeter for each PAR and size.
 - by allowing Solver to adjust the length and width dimensions.
 - perimeter had to always be greater as size increased.
- $PAR = 100 \times (\text{Perimeter Linear Feet} / \text{Floor Area Square Feet})$
- Example: For a 200 x 200 building, $PAR = 100 \times 800 / 40000 = 2$

PAR	0.5	1	1.5	2	3	4	5	6	7	8	9	10	11	12	13
Area	640000	160000	80000	40000	24000	16000	12500	10000	7500	5000	4100	3250	1800	1320	1000
Perimeter	3200	1600	1200	800	720	637	622	598	524	403	368	324	198	158	130
Exact PAR	0.50	1.00	1.50	2.00	3.00	3.98	4.98	5.98	6.99	8.06	8.98	9.97	11.00	11.97	13.00
Dimensions	800x800	400x400	200x400	200x200	85x329	62.5x256	47.5x264	38x261	33x228	29x172	26x158	24x138	24x75	24x55	25x40



Cost Schedule Update and Review

Commercial model assumptions are in Appendix D:

Appendix D General Commercial Models

General Commercial Mercantile Models

This section describes the general commercial mercantile models (GCM).

GCM Basic Shell Components

Site Preparation	Typical grading for a level site applicable to the ground floor area; bulk excavation applicable to basement area.
Foundation	
Wall types-1, 2, and 4	Concrete grade walls on concrete spread footings to support load bearing construction; concrete column footings and grade beams to support framed construction, perimeter insulation.
Frame	
Type-1	Wood and/or timber beams and columns; interior wood or steel floor and/or roof supports.
Type-2	Steel beams and columns; steel pipe floor and/or roof supports.
Type-3	Reinforced concrete beams and columns.
Type-4	Fire-protected steel beams and columns.
Exterior Walls	
Type-1 Basement	Concrete block, waterproofing, insulation at finished areas.
Type-2 Basement	Concrete, waterproofing, insulation at finished areas.
Type-1 Upper	8" concrete block curtain walls; 12" load bearing concrete block walls; painted exterior.
Type-2 Upper	8" brick on concrete block back-up curtain walls; 12" brick on concrete block back-up load bearing walls.
Type-4 Upper	4" concrete panel guard walls 2'6" high.
Ground Floor	Concrete slab with wire mesh reinforcing at grade level, vapor barrier.
Structural Floors	
Type-1 Frame	Wood sub-floor on wood joists.
Type-2 Frame	Concrete on corrugated metal deck and steel joists.
Type-3 Frame	Concrete slab and joists.

Appendix D General Commercial Models

Type-4 Frame	Concrete slab on steel joists.
Roof Structure	
Type-1 Frame	Flat roof, wood or composition deck on wood joists.
Type-2 Frame	Flat roof, steel deck on steel joists.
Type-3 Frame	Flat roof, concrete slab on concrete joists.
Type-4 Frame	Flat roof, steel deck on steel joists.
Roofing	Composition roofing, insulation
Interior Finish	See Occupancy Model - specific Components
Mechanical Features	See Occupancy Model - specific Components

MODEL	GCM Apartments
Floor Height	10'
Finish Type	Finished divided, 8' ceiling height
Interior Finish and Mechanical Features	
Walls	Two coats of paint on drywall, wood or metal furring
Flooring	30% vinyl composition tile; 65% carpet and pad; 5% ceramic tile
Ceiling	Taped and painted drywall on wood ceiling joists or metal channel supports
Partitions	Wood frame interior construction typical of occupancy
Lighting	Average cost installation typical of apartments.
HVAC	Heating only
Heating Only	Gas fired forced air
Cooling Additive	Add for air conditioning for one unit only from the Schedule C "Add for A.C." column. Air conditioning in multiple units is valued using the unit finish adjustment.
Plumbing	Not included. Plumbing is valued with the application of the unit finish adjustment.
Notes	Kitchen built-ins, plumbing and air conditioning are included by the



Cost Schedule Update and Review

Commercial models example – GCM Basic Shell Components - 1st floor

Base Floor Size	24000	16000	12500	10000	7500	5000	4100	3250
Perimeter Linear Feet	720	637	622	598	524	403	368	324
Perimeter-Area Ratio (PAR)	3	4	5	6	7	8	9	10
<i>First floor level - GCM Basic Shell with 10' Wall Height</i>								
<i>Wall Type 1</i>								
Site preparation and A1010 Standard Foundation	80096	68326	64781	61263	52738	40537	36738	32543
A1030 Slab on Grade	91440	60960	47625	38100	28575	19838	16593	13463
B1020 Roof Construction	243729	162486	126942	101554	76165	50777	41637	33007
B1030 Interior Roof Support Columns 10'	60160	47690	43270	39460	33240	24750	22110	19120
B2010 10' Type 1 Exterior Walls	59677	52797	51545	49560	43422	33395	30503	26847
B2020 Exterior Windows	24334	21538	21037	20223	17719	13628	12439	10957
B2030 Exterior Doors	49665	43917	42921	41234	36176	27822	25369	22380
D2020 Plumbing DWV rough-in and water supply piping	26986	18739	15000	12276	9468	6576	5501	4462
D2040 Rain Water Drainage	4284	3790	3700	3559	3118	2397	2190	1928
GCM Shell Components Cost - 10' Type 1 Wall	640371	480243	416821	367229	300621	219720	193080	164707
<i>Wall Type 2</i>								
Cost difference for 10' Type 2 masonry exterior walls	80628	71332	69640	66962	58668	45120	41213	36272
GCM Shell Components Cost -10' Type 2 Wall	720999	551575	486461	434191	359289	264840	234293	200979
<i>First floor level - GCM Basic Shell with 12' Wall Height</i>								
<i>Wall Type 1</i>								
Cost difference from 10' to 12' Type 1 Exterior Walls	15955	14116	13783	13252	11612	8931	8155	7180
GCM Shell Components Cost - 12' Type 1 Wall	668358	503897	439258	388373	318881	233601	205657	175711
<i>Wall Type 2</i>								
Cost difference from 10' to 12' Type 2 Exterior Walls	37512	33187	32406	31156	27300	20996	19173	16880
GCM Shell Components Cost - 12' Type 2 Wall	770543	594300	527521	473239	393237	290786	257888	221683



Cost Schedule Update and Review

Commercial models specific for certain items but vague for others

Examples: Flooring is very specific, but partitions and lighting are very general

MODEL	GCM Bank
Floor Height	14'
Finish Type	Finished divided, 12' ceiling height
Interior Finish and Mechanical Features	
Walls	Taped and painted drywall on wood or metal furring
Flooring	95% carpet and pad; 5% terrazzo or equal
Ceiling	Suspended acoustical tile
Partitions	Wood frame interior construction typical of occupancy
Lighting	Average cost installation typical of occupancy
HVAC	Zoned air conditioning warm and cooled air
Heating Only	Forced air
Cooling Additive	N/A
Plumbing	Not included



Cost Schedule Update and Review

Commercial models example – GCM Bank Use Type Finish – 1st floor

Base Floor Size	16000	12500	10000	7500	5000	4100	3250	Cost	
Perimeter Linear Feet	637	622	598	524	403	368	324		
Perimeter-Area Ratio (PAR)	4	5	6	7	8	9	10		
Type 1 Finished Divided Bank 14' wall									
GCM Shell Components Cost - 14' Type 1 Wall	527550	461696	409517	337141	247481	218234	186715		
B2020 Commercial entrance - double door	4280	4280	4280	4280	4280	4280	4280	4280.00	ea
C1010 Walls - Painted drywall on metal furring	34169	33364	32077	28107	21617	19740	17379	4.47	per SF
C1010 Partitions @ 12% density, studs/drywall, painted	144115	112590	90072	67554	45036	36930	29273	75.06	per LF
C1019 Acoustical tile suspended ceiling	54240	42375	33900	25425	16950	13899	11018	3.39	per SF
C3020 Floor Finish Terrazzo, 5%	9440	7375	5900	4425	2950	2419	1918	11.80	per SF
Carpet and pad, 95%	44485	34754	27803	20853	13902	11399	9036	2.93	per SF
D5010 Electrical - full rate	158560	123875	99100	74325	49550	40631	32208	9.91	per SF
D30 HVAC - Heating and air conditioning	268000	209375	167500	125625	83750	68675	54438	16.75	per SF
Total builder cost	1244839	1029684	870149	687735	485516	416207	346265		
Builder markup + EOS factor + VEM	12448	10297	2610	1375	22334	28302	32549	-5%	
Total Replacement Cost New (RCN)	1257287	1039981	872759	689110	507850	444509	378814		
\$ per SF	78.58	83.20	87.28	91.88	101.57	108.42	116.56	8.32	
Type 2 Finished Divided Bank 14' wall									
Total builder cost	1354315	1136569	972919	777780	554767	479456	401938		
Builder markup + EOS factor + VEM	13543	-5683	-6810	1556	25519	32603	37782	-5%	
Total Replacement Cost New (RCN)	1367858	1130886	966109	779336	580286	512059	439720		
\$ per SF	85.49	90.47	96.61	103.91	116.06	124.89	135.30	10.44	



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Perimeter-to-Area Ratio (PAR) Summary for C/I Models

Perimeter to Area Ratio PAR	Approximate Cost Model Size Used for the PAR*		Approximate Smallest Feasible Size for the PAR**		Approximate Largest Feasible Size for the PAR**	
	Dimensions	SF Area	Dimensions	SF Area	Dimensions	SF Area
1: 0.5-1.4	400 x 400	160000	265 x 290	76700	800 x 800	640000
2: 1.5-2.4	200 x 200	40000	150 x 180	27000	165 x 800	132000
3: 2.5-3.4	88 x 272	24000	105 x 130	13650	90 x 800	72000
4: 3.5-4.4	62.5 x 256	16000	90 x 90	8100	60 x 800	48000
5: 4.5-5.4	47 x 264	12500	65 x 85	5525	45 x 800	36000
6: 5.5-6.4	38 x 261	10000	60 x 65	3900	35 x 800	28000
7: 6.5-7.4	33 x 229	7500	50 x 60	3000	30 x 800	24000
8: 7.5-8.4	29 x 172	5000	45 x 50	2250	25 x 800	20000
9: 8.5-9.4	26 x 158	4100	40 x 45	1800	25 x 440	11000
10: 9.5-10.4	23.4 x 139	3250	35 x 45	1575	25 x 130	3250

* All the actual cost model PARs are within 1% of each whole number PAR

** For buildings up to 800 x 800 feet in size



Cost Schedule Update and Review

Accounting for Economies of Scale

- When more units of something are produced, it costs less to produce each unit.
- Economic efficiencies result from carrying out a process such as building construction on a larger and larger scale.
- “Every estimator knows that as quantity built increases, the unit cost decreases... when comparison projects are either much larger or much smaller than the proposed project, adjustments need to be made for the economy of scale,” wrote John D. Bledsoe (2002, p. 14), PhD, PE, author of the reference book *Successful Estimating Methods . . . from Concept to Bid*.
- The economies of scale size adjustment incorporated in the 2014 Indiana cost tables based upon Bledsoe (1992) and those found in Means (2012) tables are nearly identical.
- According to Bledsoe, when building sizes are within 10% of one another, there is little difference for which a size factor cost multiplier is needed; however, when sizes differ significantly (more than 10%) a cost adjustment multiplier is required for accurate estimates.



Cost Schedule Update and Review

Factors Contributing to Economies of Scale in Construction

- Some of the inputs that a building contractor controls in a larger construction project that contribute to economies of scale:
- Lower material costs: When a builder buys materials in bulk for larger jobs - for example, concrete, plywood, or steel – the builder can take advantage of volume discounts.
- Specialized equipment: As the scale of a construction project increases, a builder can employ the use of specialized labor and equipment resulting in greater efficiency – Example D4 tractor in slab construction.
- Learning curve effect: Each new commercial building construction project is unique with a new set of plans and requirements. The learning curve effect refers to the capability of workers to improve their productivity by regularly repeating the same type of action. The increased productivity is achieved through practice, self-perfection, and minor innovations resulting in a reduction in the number of work-hours necessary to achieve a specified amount of output.
- **An economies of scale adjustment was applied in producing residential as well as commercial and industrial cost tables.**



Cost Schedule Update and Review

Economies of Scale Cost Adjustments Used for Each PAR

Perimeter to Area Ratio	Cost Model Size Used for the PAR		Comparing PAR Size to 12500 SF	
PAR	Dimensions	SF Area	Size Factor	Cost Multiplier
1: 0.5-1.4	400 x 400	160000	12.80	0.870
2: 1.5-2.4	200 x 200	40000	3.20	0.890
3: 2.5-3.4	88 x 272	24000	1.92	0.937
4: 3.5-4.4	62.5 x 256	16000	1.28	0.976
5: 4.5-5.4	47 x 264	12500	1.00	1.000
6: 5.5-6.4	38 x 261	10000	0.80	1.023
7: 6.5-7.4	33 x 229	7500	0.60	1.052
8: 7.5-8.4	29 x 172	5000	0.40	1.096
9: 8.5-9.4	26 x 158	4100	0.33	1.118
10: 9.5-10.4	23.4 x 139	3250	0.26	1.144



Cost Schedule Update and Review

- **Trends in Residential Costs**
 - First floor costs increased 1-2%.
 - Upper story costs decreased 2%.
 - Frame and brick increased at the same rate.
 - Attic costs decreased 6%.



Cost Schedule Update and Review

2014 Residential Cost Table % Changes from 2012

Appendix C - Schedule A

Dwelling Base Price changes at 15 Benchmark Points

Area	First Floor			Half Upper Story			(+/- 1)		Full Upper Story			Unfin	Attic	Unfin		Bsmt
	1 - 5	+	6 - 8	1 - 5	+	6 - 8	1 - 5	6 - 8	1 - 5	+	6 - 8	Attic	Fin	Bsmt	Crawl	Fin
100	2%	0%	2%	2%	0%	2%	6%	6%	3%	20%	3%	3%	0%	2%	0%	0%
400	2%	0%	1%	-1%	0%	-1%	4%	2%	0%	0%	1%	-2%	-2%	1%	0%	-3%
600	2%	0%	2%	0%	0%	-1%	0%	3%	0%	0%	0%	-2%	-2%	1%	0%	-3%
800	1%	9%	2%	-1%	0%	-1%	0%	2%	-1%	0%	0%	-5%	-2%	1%	0%	-3%
1,000	2%	8%	2%	-1%	0%	-2%	0%	1%	-1%	0%	-1%	-4%	-3%	1%	-2%	-3%
1,200	2%	0%	2%	-2%	0%	-2%	0%	1%	-2%	7%	-1%	-4%	-4%	1%	-2%	-4%
1,300	2%	0%	2%	-2%	0%	-2%	0%	0%	-2%	0%	-1%	-5%	-3%	1%	-2%	-4%
1,400	1%	7%	2%	-3%	0%	-2%	-2%	0%	-2%	7%	-1%	-5%	-4%	1%	-2%	-4%
1,500	1%	0%	2%	-3%	0%	-3%	-2%	0%	-2%	0%	-1%	-6%	-4%	1%	-1%	-4%
1,600	1%	0%	2%	-3%	0%	-3%	0%	0%	-2%	7%	-1%	-6%	-4%	1%	-1%	-4%
1,800	1%	6%	1%	-3%	0%	-3%	0%	1%	-2%	6%	-2%	-6%	-4%	1%	-1%	-4%
2,400	1%	0%	1%	-3%	0%	-3%	-1%	1%	-3%	5%	-2%	-7%	-4%	1%	-2%	-4%
3,200	1%	0%	1%	-4%	0%	-3%	-1%	1%	-3%	4%	-2%	-8%	-4%	1%	-4%	-4%
4,000	1%	3%	1%	-4%	0%	-4%	-2%	0%	-3%	3%	-2%	-8%	-4%	1%	-3%	-4%
5,000	1%	3%	1%	-4%	0%	-4%	-3%	0%	-4%	3%	-3%	-8%	-4%	1%	-3%	-4%



Cost Schedule Update and Review

- **Trends in Commercial (GCM) Costs**
 - Most use types increased an average of 1%.
 - Unfinished basement use types saw an average 5% decrease.
 - Parking
 - Utility Storage
 - Stand Alone Basement
 - Parking Garage
 - These use types use structural steel beams, which decreased in cost.
 - Basement shell decreased from \$20.84 / SF to \$19.61 / SF.



Cost Schedule Update and Review

2014 GCM Cost Table % Changes from 2012 Appendix G - Schedule A.1 GCM base price changes for Selected Use Types

	Wall Type	1	2	3	4	5	6	7	8	9	10
<i>Sub Basement</i>											
Parking	2	-4%	-4%	-5%	-4%	-5%	-5%	-5%	-4%	-4%	-4%
<i>Basement</i>											
Utility/Storage	1	-5%	-5%	-5%	-4%	-5%	-5%	-4%	-4%	-3%	-3%
Utility/Storage	2	-5%	-6%	-6%	-6%	-7%	-7%	-7%	-6%	-6%	-6%
Stand Alone	1	-4%	-4%	-4%	-3%	-3%	-3%	-3%	-2%	-2%	-2%
Basement	2	-4%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-4%	-4%
<i>Upper</i>											
Parking Garage	2	-5%	-5%	-6%	-6%	-6%	-6%	-6%	-6%	-5%	-5%
Utility/Storage	1	-5%	-5%	-5%	-4%	-4%	-4%	-3%	-3%	-3%	-2%
Utility/Storage	2	-5%	-4%	-3%	-3%	-3%	-2%	-2%	-1%	-1%	-1%
Parking Garage	1	-5%	-5%	-5%	-4%	-5%	-5%	-4%	-3%	-3%	-2%



Cost Schedule Update and Review

- **Trends in Industrial (GCI) Costs**
 - Most use types decreased an average of 2%.
 - Light / Heavy Manufacturing increased by 6% on average.
 - This was due to error in 2012 HVAC cost for these models.
 - 2012 HVAC cost was \$2.79 / SF instead of \$6.36 / SF.
 - Updated HVAC cost is \$6.57 / SF.



Cost Schedule Update and Review

2014 GCI Cost Table % Changes from 2012

Appendix G - Schedule A.2

GCI base price changes for Selected Use Types

	Wall Type	1	2	3	4	5	6	7	8	9	10
<i>Basement</i>											
Light Manufacturing	1	8%	8%	8%	7%	7%	7%	7%	6%	6%	6%
Light Manufacturing	2	7%	7%	6%	5%	4%	4%	3%	3%	2%	2%
Heavy Manufacturing	1	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%
Heavy Manufacturing	2	5%	4%	3%	3%	2%	2%	1%	1%	1%	1%
Light Manufacturing	1	9%	8%	7%	7%	6%	6%	5%	5%	5%	5%
Light Manufacturing	2	8%	8%	7%	6%	6%	6%	5%	5%	5%	5%
Light Manufacturing	3	9%	8%	7%	6%	6%	5%	5%	5%	5%	4%
Heavy Manufacturing	1	8%	7%	7%	6%	6%	5%	5%	5%	5%	4%
Heavy Manufacturing	2	8%	7%	6%	6%	5%	5%	5%	5%	4%	4%
Heavy Manufacturing	3	8%	7%	6%	6%	5%	5%	5%	4%	4%	4%
<i>Upper</i>											
Light Manufacturing	1	8%	8%	7%	7%	6%	6%	6%	5%	5%	5%
Light Manufacturing	2	8%	7%	7%	6%	6%	6%	5%	5%	5%	5%
Heavy Manufacturing	1	7%	7%	6%	6%	5%	5%	5%	5%	4%	4%
Heavy Manufacturing	2	7%	6%	6%	5%	5%	5%	5%	4%	4%	4%
Loft Manufacturing	1	-6%	-6%	-6%	-5%	-5%	-5%	-5%	-4%	-4%	-3%
Loft Manufacturing	2	-6%	-5%	-4%	-4%	-3%	-3%	-3%	-2%	-2%	-2%



Cost Schedule Update and Review

- **Trends in Light Commercial (GCR) Costs**
 - First / upper floors increased by an average of 5%.
 - Increase due to roofing costs: GCR models use a heavier truss (fink truss), whose cost increased from \$5.04 / SF to \$6.13 / SF.
 - Basement costs increased by an average of 1%, since they do not include truss cost.



Cost Schedule Update and Review

2014 GCR Cost Table % Changes from 2012

Appendix G - Schedule A.3

GCR base price changes for Selected Use Types (First Floor)

	Wall Type	1	2	3	4	5	6	7	8	9	10
Motel Service	1	4%	4%	4%	4%	5%	5%	5%	5%	5%	5%
Motel Service	2	4%	5%	5%	5%	6%	6%	6%	6%	6%	6%
Dinning/Lounge	1	3%	4%	4%	4%	4%	4%	4%	5%	5%	5%
Dinning/Lounge	2	4%	4%	5%	5%	5%	5%	6%	6%	6%	6%
Bank	1	4%	4%	4%	4%	4%	4%	5%	5%	5%	5%
Bank	2	4%	4%	5%	5%	5%	5%	6%	6%	6%	6%
General Office	1	4%	4%	4%	4%	4%	5%	5%	5%	5%	5%
General Office	2	4%	4%	5%	5%	5%	6%	6%	6%	6%	6%
Medical Office	1	4%	4%	4%	4%	4%	4%	5%	5%	5%	5%
Medical Office	2	4%	4%	5%	5%	5%	5%	6%	6%	6%	6%
Motel Units	1	4%	4%	5%	5%	5%	5%	5%	5%	5%	5%
Motel Units	2	4%	5%	5%	5%	5%	6%	6%	6%	6%	6%
Funeral Home	1	4%	4%	4%	4%	4%	4%	5%	5%	5%	5%
Funeral Home	2	4%	4%	5%	5%	5%	5%	6%	6%	6%	6%
Nursing Home	1	4%	4%	4%	4%	5%	5%	5%	5%	5%	5%
Nursing Home	2	4%	5%	5%	5%	6%	6%	6%	6%	6%	6%
Apartment	1	5%	5%	6%	6%	6%	6%	6%	6%	6%	6%
Apartment	2	5%	6%	6%	6%	6%	6%	7%	7%	7%	7%



Cost Schedule Update and Review

- **Other Notable Cost Changes**
 - App. C, Sched. D: Specialty plumbing costs increased substantially, due to changes in Craftsman's methodology.
 - App. C, Sched. G.2: Earth floor addition increased from \$3.04 / SF to \$5.29 / SF.
 - App. G, Sched. E: Almost all costs updated with 1.06 cost factor.



Cost Schedule Update and Review

- **Cost Schedule Errata**
 - The Department published errata on Jan. 9 for the following schedules:
 - Schedule G.1: Bath Houses
 - Schedule G.2: Stables
 - Schedule G.2: Barns and Sheds
 - Schedule G.2: Silos
 - The errata corrects calculation errors in these schedules.
 - Most changes are minor.
 - Please enter these corrections into your system.



Cost Schedule Update and Review

- **Cost Schedule Errata**
 - App. C, Sched. G.1:
 - Bath houses for 1,100 – 1,200 SF were calculated incorrectly, and will slightly decrease.
 - Stables for 800 and 2,000 SF were calculated incorrectly, and will slightly change.
 - App. C, Sched. G.2:
 - Barns (all types) were calculated incorrectly, and will change.
 - Most changes will be minor.
 - 50x40' and 50x50' will significantly decrease.
 - Silos (24x60) will see a slight change.



Cost Schedule Update and Review

- **Location Cost Modifiers**
 - Location Cost Modifiers (LCM) were updated in February 2014 for the 2014 annual adjustment.
 - The LCMs were NOT updated for the October 2014 cost schedule update.
 - The LCMs will be updated in February 2015 for the 2015 annual adjustment, using 2015 Craftsman data.
 - The Department is reviewing LCM methodology, and welcomes your comments.



Cost Schedule Update and Review

- **Soil Productivity Factors**
 - The Department is working with Purdue University to develop updated factors.
 - Draft proposed factors increase 4% on average.
 - Soil IDs may also need updating; the Department is working on correlating old soil IDs with updated ones.
 - Stay tuned...



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